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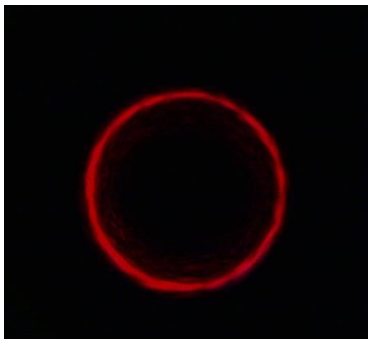
Multimode fibre

1. Evaluation of the numerical aperture with skewed rays

Show images obtained at different skew ray configurations **(2 images).** Measure the acceptance angle of the fibre and compute its numerical aperture. Provide an error estimation of the measurement. Compare the measured value with the datasheet of the fibre.

Picture1– Skewed rays	Picture 2 – Skewed rays
	

Acceptance angle by direct measurement (deg):

Error evaluation (explain how you evaluate the error):

Datasheet value for the acceptance angle θ=arcsin (NA):

Compare the measured acceptance angle and the value given in the datasheet. Explain the difference between the two values:

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2. Measurement of the numerical aperture

Show sample images of the light spots on the camera (**2 images**). Provide a table with the spot diameter as a function of distance (min. 5 points). Calculate the NA of the fibre. Provide an error estimation. Compare the value with the one obtained with skewed rays and with the datasheet of the fibre.

Picture 1 – Spots size at position 1	Picture 2 – Spot size at position 2
	

Measurement number	1	2	3	4	5	6	7
Distance in mm							
Spot diameter in pixel							
Spot diameter in mm							
Angle (deg)							
NA							

Average numerical aperture of the fibre NA=

Error estimation $\Delta NA = \Delta \sin(\theta) = \cos(\theta)\Delta\theta$

$\Delta NA =$

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Comparison with value obtained with skewed rays and datasheet. Interpret your result:

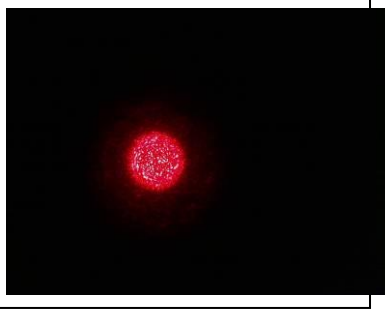
3. Injection for different sources

Show sample images of the light spots on the camera for each source **(3 Images).**

Picture 1 – Halogen

Picture 2 – LED

Picture 3 – Laser



What is special for each source? Please comment! (i.e. the granular structure of the laser, overall light level, size of the spot).

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4. Measurement of relative injection efficiency

Show the **two images**. Measure the distance between the lens cap and the entrance of the fibre for both situations and calculate the NA. Compare the total intensity for the two injection conditions by integrating the intensities with Matlab. Give the integral intensities for all images. Give the ratio for the background corrected and non-corrected value. Calculate P_1/P_2. (No error calculations needed)

Picture 1 – LED position 1	Picture 1 – LED position 2
	

Position	1	2
Distance lens cap to fibre entrance		
Numerical aperture, NA		
Total intensity no background correction		
Total intensity with background correction		

Ratio of injected power $P_1/P_2 =$

Ratio of NA $NA_1^2/NA_2^2 =$

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Compare power and NA ratio and interpret your result:

(Optional) Personal feedback:

Was the amount of work adequate?

What is difficult to understand?

What did you like about it?

How can we do better?